Risk analysis within the production process of fish preserves

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Abstract. One of the primary tasks for today is the production of high quality and safe products according to the legislation of Russian Federation. There are a number of risks within the production process. The common problem is the heat treatment process. This problem is for fish preserves. Such products can classify as perishable. It is necessary to carefully approach the choice of raw materials and compliance with all technological regimes. Since there is always the possibility of various dangers. In order to minimize dangerous factors, it is important to use a quality method with identifying the most important of them for factors matrix for production process of fish preserves proposed to develop a diagram of quality and safety indicators and identify the most important of them for further use to form a matrix of technological factors that have a direct impact on quality and safety indicators in the production of fish preserves.

1 Introduction

Providing the population with high-quality food products is the most important problem. In order to improve the situation on the food market, a special strategy has been developed to support the development of food production, according to which by 2030 the Government of the Russian Federation should develop and implement an integrated system for traceability of food quality and safety [1]. The implementation of the task includes several stages. At the first stage it is necessary to determine the factors that will affect the quality and safety indicators in the production of a food product. At the second stage, analyze them and develop a risk management mechanism [2,3].

2 Materials and methods

The study subject is the technology of food preserves. In the work, the organoleptic, physico-chemical indicators of fish preserves were studied according to GOST 7453-86 "Preserves from cut fish. Specifications". The standards for the content of hazardous substances are regulated by TR CU 021/2011 "On food safety" and TR EAEU 040/2016 "On the safety of

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fish and fish products". With the use of Delphi method scales for assesses quality were developed. For identifying factors for quality and safety of fish preserves a Pareto diagram was used.

3 Results and discussion

The studies were carried out to implement the requirements of the technical regulations of the Customs Union (TR CU) and the technical regulations of the Eurasian Economic Union (TR EAEU), the subject of technical regulation of which are food products (goods) in terms of their labeling, as well as sanitary-chemical and microbiological indicators. Based on the results of the research, a number of violations and inconsistencies were identified for fish preserves when labeling the product, which amounted to 70%, according to microbiological indicators - 28% of samples according to safety indicators and 2% according to sanitary and chemical indicators (Figure 1).
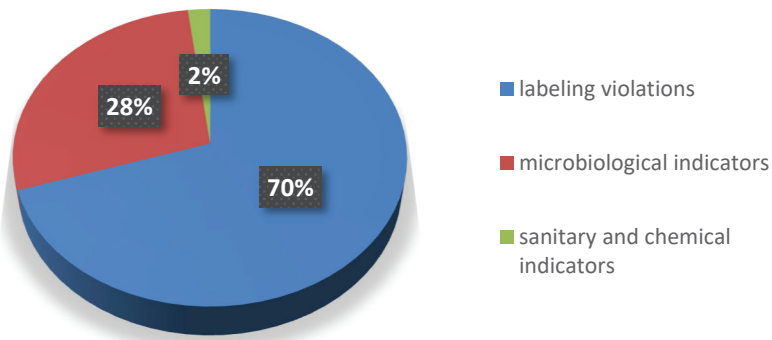

Fig. 1. The share of product samples that do not meet the established requirements for labeling, sanitary-chemical and microbiological indicators of fish preserves.

Therefore, the control of food safety and quality at the stage of production of agricultural raw materials and in the process of its processing into food products is one of the most important links in the state control system. The quality of fish preserves is determined by the quality of raw materials. Preserves from mature fish should have the following characteristics: appearance - whole fish, without damage, with a clean surface, without yellowing; texture - tender, juicy; taste and smell - characteristic of mature fish, with the aroma and taste of spices or the corresponding filling (sauce) [4].

The risk of contamination of food products and food raw materials with potentially hazardous substances can only be reduced with an effective control system at all stages of production and sale. Currently, an urgent task is to improve the methodology for assessing the quality and safety of food products and raw materials [5, 6].

In terms of organoleptic and physico-chemical parameters, fish preserves must comply with the requirements of GOST 7453-86. The content of potentially hazardous substances is regulated - TR CU 021/2011, as well as TR EAEU 040/2016.

In order to obtain high-quality and safe raw materials, it is necessary to control the factors that form the quality and safety indicators of fish preserves. If frozen fish is used as a raw material, then it is necessary to carry out an organoleptic assessment to determine its suitability for further use, as well as physicochemical analyzes. In the production of fish preserves that meet the requirements of technical and regulatory documentation, the

determining indicators will be taste and smell, appearance, mass fraction of table salt, the content of pathogenic and sanitary-indicative microorganisms, the presence of mold and yeast, as well as the content of toxic elements in fish preserves, cesium-137, strontium-90 should not exceed the permissible limits.

The importance of the safety indicators of fish preserves is determined by the principles of their equivalence: if one of the normalized safety indicators does not meet the established mandatory requirements, the fish raw material is not accepted by the plant and is unsuitable for further use at the fish processing enterprise.

Based on the results of expert assessments using the developed scales, the weighting factors for the quality and safety indicators of fish preserves were established obtained results. The results obtained formed the basis of the assessing the importance of quality and safety indicators of fish preserves (table 1) [7].

Table 1. Assessing the importance of indicators of quality and safety of fish preserves.

Indicators	Documents		
	Organoleptic indicators (GOST 7453-86 "Preserves from cut fish. TU")	**Physical and chemical indicators (GOST 7453-86 "Preserves from cut fish. TU")**	**Safety indicators according to TR TS 021/2011 "On food safety", TR CU 040/2016 "On safety of fish and fish products"**
		Weighting coefficients	
Appearance	0.31	-	-
Taste and smell	0.44	-	-
Consistency	0.25	-	-
Mass fraction of sodium benzoate	-	0.27	-
Mass fraction of table salt	-	0.36	-
The ratio of the mass of fish and marinade	-	0.14	-
The presence of foreign impurities and struvite crystals	-	0.23	-
Pathogenic microorganisms, incl. salmonella	-	-	0.16
The presence of mold and yeast	-	-	0.28
Parasites: larvae of trematodes, cystodes	-	-	0.21
KMAFAnM	-	-	0.22
Heavy metals and radionuclides	-	-	0.13

Based on the weight coefficients, the most significant indicators of quality and safety are taste and smell, appearance, mass fractions of common salt and sodium benzoate, the presence of impurities and struvite crystals, the content of heavy metals and radionuclides, as well as the presence of pathogenic microorganisms, mold and yeast.

The results of studying the connectivity between technological factors and indicators of the quality and safety of fish preserves, presented in the form of a matrix diagram (Table 2).

Table 2. Matrix of influence of factors on the formation of quality and safety indicators in the production of fish preserves.

Quality and safety indicators	VP	Factors that form indicators of quality and safety of technological processes in the production of fish preserves							Weight indicator (II)
		Reception of raw materials and storage	Defrosting, sorting and washing of raw materials	Ambassador	Skinning and portioning	Marinade preparation	Dosing and packaging of fish preparations in containers, adding marinade	Ripening and storage of the finished product	
1	2	3	4	5	6	7	8	9	10
Organoleptic indicators									
Appearance	4	●	○	-	●	○	○	○	108
Taste and smell	5	●	●	●	-	○	●	●	240
Consistency	3	●	○	○	○	○	○	○	81
Condition of fish and mixture	2	●	○	●	-	●	●	○	84
(Factor weight, Fogr.p.)		126	72	72	45	54	84	72	525
Physical and chemical indicators									
Mass fraction of table salt	4	-	-	●	-	●	●	●	144
Mass fraction of sodium benzoate	3	-	-	-	-	●	●	●	81
The ratio of the mass of fish and filling	2	-	Δ	○	Δ	-	●	○	34
Presence of foreign matter	3	●	○	Δ	-	●	-	-	66
(Weight factor, Fff-h.p.)		27	11	45	2	90	81	69	325
Safety performance									

Indicator	P								Total
Pathogenic microorganisms, incl. salmonella	4	●	●	○	○	-	Δ	○	112
Molds and yeast	4	●	●	●	Δ	○	●	●	196
KMAFAnM	3	●	●	●	Δ	○	○	●	129
BGKP	4	●	●	○	Δ	-	Δ	○	104
Parasites: larvae of trematodes, cystodes, nematodes, acanthocephalans	4	●	●	●	Δ	-	Δ	Δ	120
Heavy metals and radionuclides	5	●	○	○	-	Δ	-	Δ	85
Factor weight, (Fp.b.)		216	186	138	27	26	57	96	746
Factor weight for all groups of indicators (Fgen.)		369	269	255	74	170	222	237	1596

Δ – weak relationship (weight 1 point); ○ – average relationship (weight 3 points); ● – strong relationship (weight 9 points)

The value of the weight of the quality and safety indicator (P) indicates the sensitivity of this indicator to the influence of various factors, and the weight of the factor (F) characterizes the importance of all factors in shaping the quality and safety of fish preserves. In order to establish the most significant stages in the production of fish preserves, which will primarily affect the quality and safety of the finished product and, therefore, requiring special control in production, a Pareto diagram was used (Figure 2).
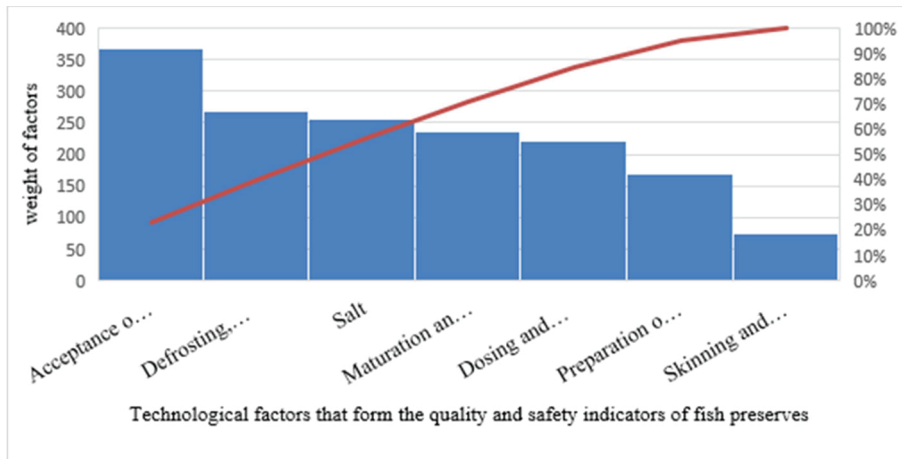
Fig. 2. Diagram of Pareto-technological factors that form the quality and safety indicators of fish preserves

After analyzing the diagram data, it was concluded that each of the technological factors has a certain impact on the quality and safety of fish preserves, but the most significant are: acceptance of raw materials and storage, defrosting, sorting and washing of raw materials, salting, ripening and storage of the finished product they should first of all be paid attention to in the production of a food product.

4 Conclusion

Today, it is need to apply new approaches for minimizing the risk of manufacturing products. It is necessary to control raw materials at the stage of fish acceptance during the production of fish preserves. The developed matrix of the influence of factors on the formation of quality and safety indicators in the production of a food product made it possible to determine the importance of the studied technological and raw materials factors and the lability (variability or instability) of the risks of producing low-quality and unsafe products. And to establish that the following factors have the highest values of importance indicators: acceptance of raw materials and storage (369), defrosting, sorting and washing of raw materials (269) salting (255), maturation and storage of the finished product (237).

The proposed approach will reduce the production of defective products and increase production efficiency, and it can also be used in the development of a risk analysis system in food production, the operation of which is a mandatory requirement of TR TS 021/2011 "On Food Safety".

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